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Electrochemical impedance spectroscopy is a versatile technique for new challenges in 3D cell culture

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Microtissue technology and 3D cell culture models have recently gathered attention by the scientific community since they more effectively promote physiological functions of cell differentiation and mimic tissue organization. In order to support cell adhesion and proliferation, and stimulate the biological cross talk between cells and scaffold, the physico-chemical properties and structural characteristics of the scaffold should be chosen carefully¹. Electrical impedance spectroscopy (EIS) has proven to be a powerful method to characterize passive electrical properties of inorganic and organic materials² but also of biological systems both *in vivo*³ and *in vitro*⁴.

Different generations of EIS based sensors are here presented which were designed and optimized in order to characterize new 3D polymeric scaffolds in terms of effective conductivity, porosity and compactness.

The sensitivity field for EIS measurements on a volume conductor largely depends on the electrode geometry (size, shape and orientation) and configuration (2-, 3- and 4-probe measurements). Hence, different sensing configurations were designed, evaluated by finite element simulations (Comsol Multiphysics) and experimentally characterized.

EIS characterization of scaffold materials and real-time monitoring of biological cell growth under static and perfusion culture conditions were carried out.

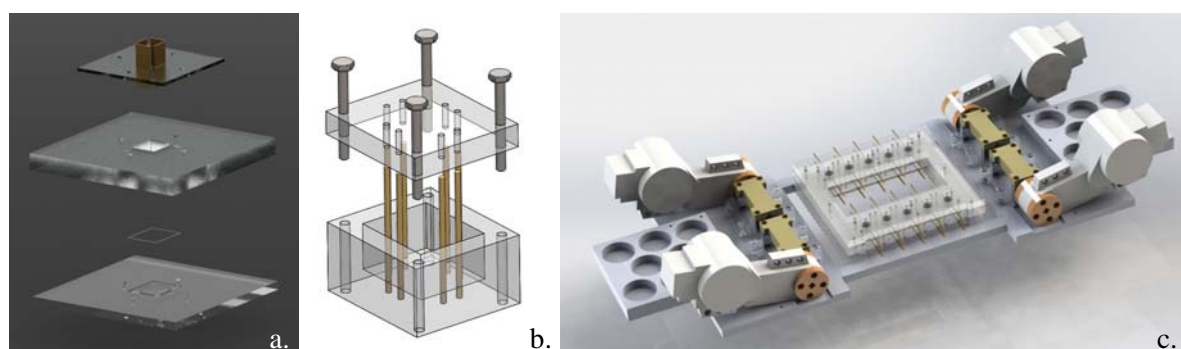


Figure 1: Three generations of sensors for 3D cell culture under static (a, b) and fluidic (c) conditions.

This method sets a next concrete perspective towards electrical impedance tomography applications for on-line imaging of dynamic 3D cell culture environments.

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